"DENTAL TREATMENT SYSTEM"

Description

The present invention relates to a hopper especially for holding medical instruments and an apparatus for holding the hopper.

Moreover the present invention relates to a medical instrument and an apparatus for holding the instrument.

Furthermore the present invention relates to a system which in addition has a providing device and/or a treatment device.

Electrically driven drills are used especially in dentistry for dental treatment as medical endo-instruments as they are called. The drill is driven by an electric motor, and is supported, for instance, in a dental handpiece of a treatment device.

According to prior art, as it is disclosed e.g. in publication DE 198 20 639 A1, the drill is driven by a step motor. An adequate control means for the step motor is adapted to monitor and control an admissible torque load limit and/or an admissible torque range of each drill used. The control is performed via the current intensity applied and the rotary-field frequency.

Comprehensive experiments furnished the result that by using a step motor to drive currently known endo-instruments the latter are prevented from breaking in practical use. In this context, the effect of "falling out of step" of step motors is exploited which at the most causes stalling of the motor in the case of overload. The

effort in terms of control remains extremely small and is substantially restricted to adjusting the current intensity and to generating a pulse for the step motor.

In other words, this development permits the enlarged use of electric drives to instruments having a low breaking load while the risk of break of an instrument is considerably reduced. This opens the opportunity of using an instrument for several times. Now it has turned out that the breaking load limits for endo-instruments and/or endo-drills established by the inventor in the meantime are subjected to changes with an increased time of use. Within the scope of tests for some endo-instruments a maximum time of use within which the breaking probability is low and the cutting efficiency of the instruments is sufficient could be established by analysis. When this maximum time of use was exceeded, increasingly breaks due to material fatigue and a considerable deterioration of the achieved cutting performance occurred.

In order to be able to fully exploit the performance and the safety potential of the drive concept newly developed by the inventor, an as exact knowledge of the state of the used instrument as possible is required to prevent in any case breaking not only due to an improper drive (excessive load) but due to material fatigue during too long use. It is moreover necessary to make the information about the state of an instrument available to the user in an as simple and safe manner as possible.

As it is disclosed in a further prior art according to DE 198 20 640 A1, a hopper is prepared for different instruments in which the instruments are stored numbered or otherwise encoded. For different types of medical treatment hoppers including various drills which are inserted in

predetermined orders in the hopper can be prepared. The order and the type of drills as well as operating parameters of the individual drills can be entered into a computer of a providing device and can be administered there. The providing means may also be a PC.

It is the object of the invention to provide a system for identifying and monitoring a medical instrument by which the safety of a medical treatment can be increased while at the same time the application is simplified.

According to the invention, this object is achieved by a medical instrument and/or a hopper comprising the features of claim 1, a device comprising the features of claim 15 and/or a system comprising the features of claim 29.

In accordance with the invention, a hopper for holding at least one medical instrument shows encodings which can be varied taking information of use about the instrument into account. In this way the information relating to the instrument is available at the hopper and thus in direct vicinity of the instrument. In this way any confusion is excluded. Moreover, during transport of the hopper the information is carried along. The encoding may be performed in any way as long as the identifiability and variability according to the invention are ensured. When using plural instruments, an individual independent encoding may be assigned to each instrument held by the hopper and/or to the position of the instrument.

It is especially advantageous that the medical instrument comprises encodings which are variable taking the information of use concerning the instrument into account. Thus the information is provided directly at the instrument.

According to a further preferred embodiment, the hopper has fixed encodings which are suited for identifying a particular hopper and/or a particular medical instrument. In this way it is furthermore ensured that no confusion of hoppers and/or of medical instruments occurs. At the same time a set of data can be directly assigned to a hopper.

It is especially advantageous that the medical instrument has fixed encodings which are suited for identifying a particular medical instrument and/or a particular hopper. In this way the confusion of hoppers and/or medical instruments can be avoided by the information at the instrument.

According to a further preferred embodiment, the encodings and/or fixed encodings can be stored in at least one transponder as data carrier element fixedly attached to the hopper. In this way the transponder as data carrier element can be prevented from being separated from the hopper, whereby an assignment of the same can be impeded.

It is especially advantageous that the transponder is fixedly arranged at the medical instrument. In this way the transponder as data carrier element can be prevented from being separated from the medical instrument, whereby the assignment thereof can be impeded.

In accordance with a further preferred embodiment, the transponder is formed integrally with the medical instrument.

According to a further preferred embodiment the transponder is adapted to be brought into contact with a step of the medical instrument. This restricts the movement of the

transponder in the axial direction of the instrument. Moreover the transponder is held in contact with the step by a sleeve which is attachable to the medical instrument. Thus the movement of the transponder in axial direction becomes largely impossible.

According to another preferred embodiment, the shaft of the medical instrument, the transponder and the sleeve have substantially the same outer diameter. Hence the medical instrument can be designed so that it is not substantially different from a medical instrument having no transponder and can be used together with devices according to prior art.

In accordance with another preferred embodiment, the transponder is designed to be attachable to the medical instrument and/or detachable from the same. Thus the transponder can be exchanged and consequently further used if the limit of the life of the medical instrument is reached.

According to a further preferred embodiment, the transponder is provided at a periphery of the medical instrument. The medical instrument may be a rotationally symmetrical element. The outer diameter of the operative instrument can be minimized by a transponder provided at the periphery of the instrument. Moreover extended functions of reading in and out the information of the transponder can be made possible.

According to a further preferred embodiment, the information of use includes the position of the instrument at the hopper, an instrument-specific admissible accumulated load of the instrument, an accumulated partial load of the instrument and/or the number of sterilizing

cycles performed for the instrument. Thus information can be provided which improves the operating safety and the application during the treatment. The information of use may also include the type, the structure, the parameters of use and other information relating to the drill and the medical instrument itself, respectively, as well as the number of admissible and/or previously performed cycles of treatment.

According to another preferred embodiment, the instrument is a dental drill, preferably an endo-drill.

According to another preferred embodiment, the hopper can be covered by a cover which is preferably at least partly transparent and is resistant to a sterilization for instance by autoclaving. Thus the arrangement of the drills and the drills themselves can be visually inspected even in a stored state of the hopper, especially when the cover is attached. To this end, the cover is preferably transparent at least on the upper side.

Preferably the medical instrument including the transponder or the hopper including the transponder and/or the encoding and the instrument can be sterilized preferably by autoclaving. This ensures that the sterilizing operation remains possible as usual. The encoding and/or the transponder are thus resistant at least to the conditions during autoclaving.

According to the invention, an apparatus for holding a medical instrument and/or a hopper including at least one medical instrument comprises a means for identifying encodings of the medical instrument and/or the hopper and for varying the encodings taking the information of use concerning the instrument into account. By this apparatus,

the encodings can be updated concerning the information of use of the drills as well as identified and read in, respectively.

In accordance with another preferred embodiment, the means of the apparatus is adapted to identify fixed encodings of the medical instrument and/or of the hopper which are suited for identifying a particular medical instrument and/or hopper. In this way any confusion of the hoppers and the medical instruments, respectively, is avoided and a set of data can be assigned to a hopper or a medical instrument.

In accordance with a further preferred embodiment, the means of the apparatus is capable of identifying encodings and/or fixed encodings which can be stored in at least one transponder fixedly arranged at the medical instrument or at the hopper as data carrier element.

According to a further preferred embodiment, the information of use includes the position of the instrument at the hopper, an instrument-specific maximum load accumulation and/or a partial load accumulation of the instrument. In addition or as a substitute, also an auto-declaration of the position of the drill at the hopper is provided. In this context, markings are disposed in the form of ciphers, letters, colors or other distinctive features at the positions of the drills which can be easily assigned to the drills. Preferably color markings corresponding to color markings of the drill are disposed at the holes of the hopper.

According to another preferred embodiment, the apparatus comprises a treatment device for controlling and driving

the medical instrument, wherein the instrument is a dental drill, preferably an endo-drill.

Furthermore, the apparatus is connected to the treatment device for data transmission. Thus, inter alia data relating to the use of an instrument can be transmitted between the treatment device and the transponder of the hopper and/or of the medical instrument.

According to a further preferred embodiment, a contact-less data transmission is performed by the data transmission means between two elements of the treatment device separable from each other. This permits the data transmission for instance between an elbow and a handpiece which are usefully separable from each other to adapt the configuration to the treatment.

The data transmission can be especially realized by an electric plug-in connection. This type of transmission is particularly simple and safe.

According to another preferred embodiment, the data transmission means transmits the data in an inductive way. An inductive data transmission can be performed by known methods in a simple and safe manner.

According to a further preferred embodiment, the data transmission means has an induction coil at each of the two elements separable from each other. Induction coils permit the contact-less data transmission, are moreover inexpensive and can be sealed so that no additional sensitivity to environmental influences is resulting.

According to a further preferred embodiment, the elements of the treatment device separable from each other comprise a handpiece and an elbow.

According to a further preferred embodiment, the apparatus is disposed at the handpiece. Thus the data of the transponder can be processed and/or transmitted or read in/written at the medical instrument and/or at the hopper by handling the elbow.

In accordance with another preferred embodiment, the device comprises a providing device for supplying and selecting the hopper and/or the drills to be used or the medical instrument (drill types), respectively, the apparatus being connected to the providing device for data transmission. This permits a data exchange between the hopper and/or the medical instrument and a providing device which includes data concerning the treatment and concerning the instruments to be used, for instance in a computer.

Moreover, according to the invention a system consisting of a medical instrument and/or a hopper and an apparatus is provided. Also the treatment device may be part of the system. Furthermore, the system may be additionally provided with a providing apparatus. Thus, a coordinated system which increases the operating safety and simplifies the application can be provided.

Hereinafter the invention will be illustrated in detail by way of preferred embodiments with reference to the enclosed drawings.

Fig. 1 shows an embodiment of the hopper according to the invention.

Fig. 2 shows an embodiment of a system according to the invention comprising the hopper according to Fig. 1 and devices for identifying and varying the encodings of the hopper which can be connected to a treatment device and a providing device for data transmission.

Fig. 3 shows a medical instrument provided with an annular transponder as a further embodiment of the present invention.

Fig. 4 shows another embodiment of the present invention in which a data transmission means and a device for reading in/writing data are provided at a handpiece-elbow combination.

Fig. 5 represents a further embodiment of the medical instrument including the transponder according to the invention.

First of all, the hopper according to the invention will be illustrated in detail according to an embodiment with reference to Fig. 1. The hopper 1 comprises a stable body at the upper side of which holes 3i are provided. The inside diameters of the holes 3i are selected so that drills 4i can be introduced tip first into the holes and in this way can be stored in the hopper.

Alternatively, the hopper may also be designed such that the drills are received with the shaft and the bits project at the upper end of the hopper.

At one side, the hopper shows an identification mark ID by which each hopper is identified as a unique. Moreover at each individual hole 3i a discrimination mark 5i is arranged likewise visibly at the upper side so that each

individual hole can be discriminated from the other holes. These discrimination marks may have different colors, ciphers, letters or other characters.

Moreover, at least one transponder 2 is arranged at the body 1 of the hopper. The transponder 2 is fixedly attached to the body 1 of the hopper. The transponder 2 includes a data storage element containing data which are invariable and/or variable. The invariable data and the fixed encodings, resp., in the data storage element relate, for instance, to the identification mark of the hopper. This mark is fixed once, for instance during manufacture of the hopper 1 with the transponder 2. The visible identification mark need not necessarily correspond to the stored mark of the hopper. The variable data in the data storage element include information concerning the drills stored in the hopper. Hereinafter the course of action when using the drills is discussed in detail with reference to Fig. 2 for explaining the information concerning the drills.

Fig. 2 shows an embodiment of a system according to the invention including the hopper according to Fig. 1 and devices for identifying and varying the encodings of the hopper which are connected to a treatment device and a providing device for the data transmission.

For preparing a hopper 1, this hopper is preferably equipped with different drills 4i for a particular treatment procedure. The equipment and the order of the drills for the hopper 1 can be taken from a program by entering the selected treatment procedure into a computer-aided providing device P. The drills are inserted into the hopper at the predetermined positions either manually corresponding to the data of the program or an already prepared hopper which corresponds to the requirements is

provided. Via a device 7 the data concerning the drills are transmitted to the data storage element. To this effect, the hopper 1 including the transponder 2 is brought into the vicinity of the device 7 and thereby the information is exchanged between the device 7 and the transponder 2. Thus the hopper 1 is ready for use during the treatment. For this purpose the hopper is provided at a treatment device B.

The data storage element of the transponder 2 at this moment contains, apart from the identification mark, information concerning the type and position of individual drills, the previous accumulated load of each individual drill. The accumulated load of a drill includes the duration and the type of load of the drill to which a drill has been exposed by the current point in time. The load can be theoretically determined, for instance, from values for the number of rotations performed, the torque, the service life and the number of sterilizing cycles. Moreover information concerning the admissible accumulated load which must not be exceeded during treatment is provided concerning a drill.

At the beginning, the doctor in charge selects the planned treatment procedure at the treatment device. The data in the data storage element of a hopper are then read into the treatment device, whereby both the ID of the selected hopper and the data concerning the drills of the hopper are made accessible to the treatment device. For reading in the information of the data storage element, the hopper is brought into the vicinity of the device 9.

After the instrument, for instance a flexible spiral drill for a root-canal preparation, has been inserted into the handpiece and the computer of the treatment device has been

informed about the instrument used, the doctor begins with the treatment by starting the drive apparatus. Upon starting the drive apparatus the computer of the treatment device continuously evaluates for instance the operating time, the current intensity as initial value for determining the load intensity, the speed and/or, in the case of a step motor, the number of cycles as reference value of rotations performed and stores this evaluation as status-specific values in an intermediate memory. In addition, it is provided that the treatment cycles and/or the sterilization cycles are counted and stored especially for a selected one or for all drills.

After completion of the treatment the doctor switches off the drive apparatus or alternatively enters a termination signal into the treatment device to inform the latter of the end of treatment. The computer now evaluates the measured and stored status-specific values representing a load profile for the previous treatment and herefrom calculates an accumulated theoretical partial load. This partial load is now added to an accumulated total load of possibly preceding treatments using the same instrument so as to update the accumulated total load for this instrument. These data are then transmitted into the storage element of the hopper 1 via the device 9.

The instrument used by the doctor is returned into the container after treatment. The container and the instruments are subsequently cleaned and subjected to a sterilizing operation. It has turned out in tests that this sterilizing operation attacks the instruments and results in an accelerated ageing of the material, especially in a blunting of the instruments. For this reason also the number of sterilizing cycles is evaluated and stored in the storage element of the hopper.

The treatment system now compares, after updating the actual status-specific values, especially the total number of sterilizing cycles and the total load, these actual values with the maximum admissible instrument-specific values for the instrument used and outputs a warning signal which informs the doctor of the necessary exchange of this instrument upon reaching or exceeding one of the maximum values. In this case, the doctor will no longer put the instrument into the container, but will replace it by a new one.

As it is evident from the foregoing description, in this embodiment the actual state of the instrument is determined and compared to the maximum admissible state not before the completion of a treatment. However, the case may occur that already in the course of a treatment for instance the maximum time of use, i.e. the predetermined maximum total load quantity is reached or even exceeded. In order to solve this problem in a simple manner, according to the preferred embodiment a safety factor which is selected such that this actual maximum load quantity cannot be reached within the scope of an average treatment by the respective instrument is included when determining the maximum total load quantity.

Hereinafter a further embodiment of the present invention which has turned out to be especially advantageous is described with reference to Fig. 3 and Fig. 4.

Fig. 3 shows a medical instrument 4i provided with a transponder 2. The medical instrument comprises a treatment bit 42 and a shaft 41. The medical instrument 4i is driven via a step 43 at the shaft 41.

Fig. 4 shows a medical treatment device comprising an elbow 30 and a handpiece 20. The elbow 30 is detachably disposed at the handpiece 20. At the free end of the elbow 30 an instrument holding head 31 is arranged. A data transmission means 10, 11 is arranged between the elbow 30 and the handpiece 20. This data transmission means includes an induction coil 10 at the elbow 30 and an induction coil 11 at the handpiece 20. The induction coils 10, 11 are adjacent to each other or at least arranged closely to each other in the assembled state of the elbow and the handpiece.

The medical instrument 4i can be inserted in the instrument holding head 31. Thus the medical tool can be engaged with a drive unit provided in the elbow 30 via the step 43.

Moreover a reading/writing means 32 for the transponder 2 of the medical instrument 4i and/or the hopper 1 is arranged at the instrument holding head 31. This reading/writing means 32 corresponds to the device for identifying encodings of the instrument 4i and/or of the hopper 1 and for varying the encodings taking the information of use concerning the instrument into account which has been described in the preceding embodiment.

Via a wiring 15 the reading/writing means 32 is connected to the induction coil 10 provided in the handpiece 30 for data exchange.

The wiring 15 including the induction coils 10 and 11 serves as a data line for the devices for varying and identifying encodings at the hopper and/or at the medical instrument. Consequently, varying and identifying the encodings can be performed at the reading/writing means 32 or at the device in the handpiece in that a medical

instrument or a hopper including a transponder is brought into the vicinity of the reading/writing means or the device for instance in the handpiece.

The afore-defined information of use concerning the medical instrument 4i can be read in/written via the reading/writing means 32 apart from further data. According to this embodiment, the data transmission is performed via the data transmission means 10, 11, the wiring 15 and the reading/writing means 32 at the instrument holding head 31.

The reading/writing means 32 is also suited, according to the present embodiment, for reading in/writing the data of the transponder 2 which is arranged at the hopper 1 of the first embodiment.

The present embodiment differs from the preceding embodiment by the fact that the transponder 2 according to the present embodiment is arranged at the medical instrument 4i, whereas the transponder 2 according to the preceding embodiment is arranged at the hopper 1. It is also possible that both the hopper 1 and the medical instrument 4i are provided with a transponder 2.

In accordance wit the invention, the information of the transponders 2 at the hopper and/or at the medical instrument can be read in/written by the reading/writing means 32 or a reading/writing means arranged separately therefrom.

The transponder 2 according to the present embodiment consists of an annular element capable of being attached to the outer periphery of the medical instrument. An antenna for data transmission with the reading/writing means can be integrated in the transponder 2.

According to the embodiment illustrated in Fig. 5, the transponder is slipped on a reduced diameter of the shaft of the drill. An axial side surface of the transponder is brought into contact with a step 45 at which the area having a reduced diameter is converted into the area having a normal diameter and/or the shaft diameter. For restricting the axial movement of the transponder 2 a sleeve 40 is slipped onto the area having a reduced diameter. This sleeve 40 axially forces the transponder 2 against the step 45. The position of the sleeve 40 can be fixed by way of surface friction by pressing on, by gluing or any other suitable method.

In accordance with the embodiment shown in Fig. 5, the outer diameters of the sleeve 40, of the transponder 2 and of the shaft 41 are substantially identical. Especially the circumferential surface of the instrument is substantially not uneven in the area between the sleeve 40 and the shaft 41.

It is noted that the functions of the transponder, of the devices for identifying and varying the encodings of the hopper, the definitions of the information of use concerning the medical instrument described in the preceding embodiment are equally applicable to the present embodiment.

The embodiments shown are to be of an exemplary nature only. The embodiments are not intended to restrict the invention defined in the enclosed claims. The embodiments illustrated may be combined with each other at will.

Abstract

A medical instrument (4i) and/or a hopper (1) as well as a device (7, 9) for identifying and varying encodings at the hopper form a system by which the state of instruments adapted to be accommodated in the hopper can be monitored. To this end, encodings which include information concerning individual instruments are arranged at the medical instrument 4i and/or at the hopper 1. These encodings can be varied by the device (7, 9) taking the state of the instruments into account.

[Fig. 1]